

An Augmented Reality Model Sharing Platform for Virtual Design Critiques

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Abstract

This paper presents an application of Augmented Reality, which allows users to share, review and provide feedback using Augmented Reality objects. The primary objective is to use this application and integrate it in to a virtual critique platform to be used in Architectural and Interior Design critiques/reviews.

Keywords

Augmented Reality, Design Critiques, Architecture, Virtual Reality, Online Design Education

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1. Introduction

The practice of architecture and design as well as design education, while becoming global in scope, is constantly exploring emerging technology for effective distance communication. There have been a number of studies conducted on the viability of virtual tools for online design studios, which are the core components of design education. The main objective of this proposal was to develop an online platform for reviewing Augmented Reality design prototypes in the context of design education. While the main focus is on design education, it is expected that the platform might be used in other domains as well.

Prototyping or model making in the Architectural and Interior Design process is an established method of design problem solving (Chandrasekera and Yoon, 2015a; Chandrasekera, 2014). By using prototypes, design students can better visualize structures and can provide students with a more concrete solution when working on a design project. Some researchers suggest that digital prototyping using Tangible User Interfaces (TUI) such as Augmented Reality, allows the opportunity to make more inferences from the visuo-spatial features freeing designers from fixation effects by reducing

the cognitive load imposed on the user (Chandrasekera and Yoon, 2015b; Kim and Maher, 2008).

There have been a number of studies conducted on the viability of online tools for online design studios (Broadfoot and Bennett, 2003; Kvan, 2001; Chandrasekera, 2015). However, one drawback of these online design tools is the inability to use tangible building models in the critiquing process. We propose the ARMeX: Augmented Reality Model eXchanger as a method of incorporating tangible interaction between virtual models and the user.

Augmented Reality is a technology through which the view of the real world environment is mapped to a virtual environment by computer generated objects (Rabbi, Ullah and Khan, 2012). The basic goal of Augmented Reality is to enhance the interaction and perception of user with real world which is achieved by overlaying 3D virtual objects in the real environment (Azuma, Bailiot, Behringer, Feiner, Julier, and MacIntyre, 2001). While there are now many methods of developing Augmented Reality applications, in this study we adopted "Processing", a flexible software sketchbook and a language in order to develop ARMeX. Processing is a powerful open source programming language for Processing Development Environment (PDE) which

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contains sketchbook written in Java (Reas and Fry, 2007).

In order to visualize 3D objects on two remote screens, it is possible to establish a Virtual Private Network (VPN) between the computers with the help of private server space. This creates a tunnel for data transfer which helps in secure communication and data transmission.

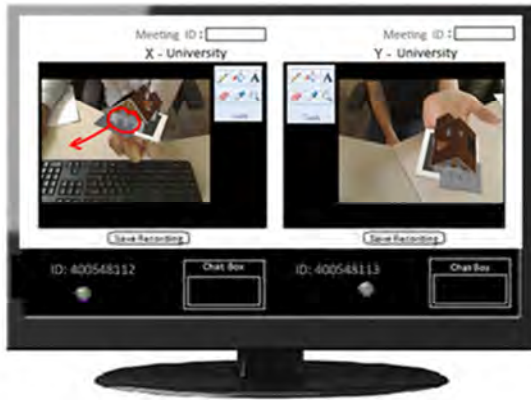


Fig. 1. Application interface of the ARMeX: Augmented Reality Model Exchanger.

2. Virtual Critiques

Design reviews, or design critiques are an essential part of design education. The idea of design reviews stems from the early design studios at Ecole des Beaux Arts in Paris and embody elements of the master-apprentice design pedagogy. The concept of learning through experience -which is considered a constructivist approach in design education- has been at the foundation of design education

Design critiques can take many forms. While design critiques are considered educational tools that help students improve their design projects, these can be divided into two main types: *Interim design critiques* and *Final design critiques*. Final design critiques focus on providing feedback that may help the student in future projects. Interim design critiques on the other hand are considered a part of providing feedback on the design project at an intermediate iteration of the design. Utaberta, Hassanpour, Zaharin, and Surat (2010) provide other types of critiques such as Individual critique, Formative critique, Peer Critique, Group Critique, Public Critique, Written Critique, Seminars and Panel Discussion which can be also considered as either interim critiques or final critiques.

Traditional design critiques help students prepare for real world issues of facing criticism by clients, and to be more professional in providing answers to questions posed. These design critiques often take place in the design studio. With online education becoming ever more popular, there is a growing need to facilitate these design critiques through an online medium. Online virtual environments have been used

The features of ARMeX include live webinar for parallel display, list of participants and active participant display, editing toolbox, chat box window for capturing all comments and discussion in text, option to save the complete Webinar for review in future.



in design education for design exploration, communication/collaboration, and presentation of ideas (Schnabel and Kvan 2002). Previous studies have extensively discussed the use of online virtual critiques as a pedagogical tool for online design education (Chandrasekera, 2015).

This paper presents a module that can be used in a virtual critique platform. The proposed module is based on Augmented Reality and is termed as an Augmented Reality Model Exchanger, where two remotely located users can share an Augmented Reality model in real time. This module will be useful in supplementing the need of a physical model within an online virtual environment.

3. Augmented Reality in Design Education

VR has been extensively used in educational environments. As AR technology is becoming more accessible, it is being more often adapted for mainstream use. While VR can generally be interpreted as an immersive three-dimensional computer-generated environment, AR can be thought of as overlaying of the virtual over the physical environment.

AR has been defined as a variation of VR (Azuma, 1997). While VR completely immerses the user inside a computer-generated environment where the user cannot relate to the physical environment, AR allows the overlaying of virtual elements onto the physical environment. AR can be considered a hybrid of virtual and physical environments and therefore supplements reality rather than replacing it. Given the similarities and overlapping of certain characteristics between these two interfaces (AR and VR), there is a critical

need to identify advantages or disadvantages of one over the other for its use in a specific domain. Augmented Reality is an interface that allows tangible interaction through the use of fiducial markers. This is also termed “desktop Augmented Reality” in the literature. In this paper, fiducial marker-based AR is used with a webcam. A desktop AR system uses a webcam, a desktop or laptop computer, and a fiducial marker. The virtual object is overlaid on the marker and displayed on the computer screen. In most cases the webcam is facing the viewer. The cost-effective nature of desktop AR has provided the opportunity for its use in many domains.

A number of studies have explored desktop AR solutions for a variety of uses including education, medicine, and design and design education (Burke et al., 2010; Chen, 2006; Chandrasekera, 2014; Jeon, Shim, & Kim, 2006) Previous studies have shown that not only can these type of AR experiences be used in design education but such experiences have been shown to be preferred by design students as an instructional medium as and to improve their spatio-cognitive

abilities (Chandrasekera & Yoon, 2015; Martín-Gutiérrez et al., 2010).

4. The Application

The Processing Development Environment (PDE) consists of a simple text editor in which sketches are written. After pieces of software called sketches are written in the text editor, it is compiled and executed through the run function in the toolbar of PDE. This helps in displaying images, objects, texts and buttons and for turning the camera on and off as well. In order to implement the Augmented Reality application through Processing, NyARToolkit is required. NyARToolkit is derivative of ARToolkit-2.72.1. NyARToolkit (nyar4psg) is downloaded and installed in contributed libraries in Processing. GSVideo is used to obtain webcam stream into Processing. The NyArtoolkit includes two maker patterns (Hiro and Kanji)

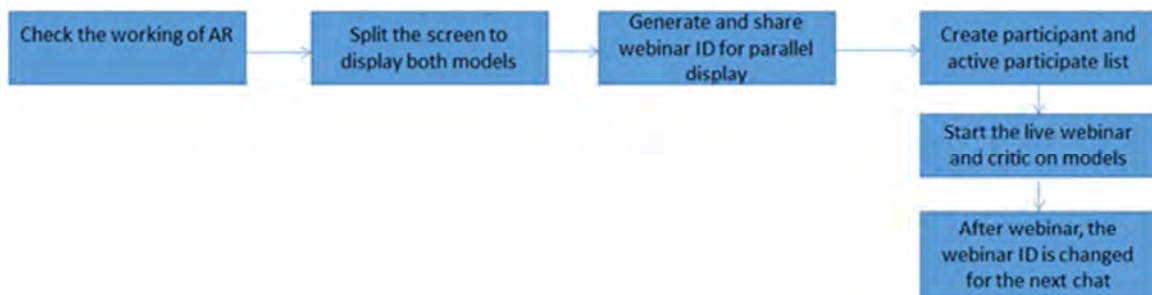


Fig. 2. Workflow diagram of implementing the system.

The objective of displaying the augmented view of 3D objects in dual screen can be divided into two parts.

The first part consists of the following series of steps. The program is written in Java into the Processing software in order to display buttons to open the file location and save the required 3D file object in the destination (inside the Processing folder), load the 3D object and turn on the camera in order to display the 3D object in virtual environment.

The second part consists of connecting to remote computer in order to access the camera of remote desktop. The Static IP address or dynamic IP address cannot be used to achieve the remote connection since the IP address changes for different computers with time and environment. This can be achieved through establishing a Virtual Private connection between the two desktops which creates a gateway for the computers in different environments to communicate with the help of IP address.

Once, the above two parts are completed, the system then is able to combine the two parts in order to obtain the main objective of displaying the augmented view of 3D objects.

5. Conclusion

An Augmented Reality application is presented which helps the two remote users to share an Augmented Reality object which can be used to comment and make observations. The primary focus of developing this application was to adopt it within a larger virtual critique frame work, that would enable design students to participate in virtual critiques.

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